SCIENCE

Vol. 84 FRIDAY, JULY 17, 1936 No. 2168

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

CHEMICAL RESEARCH, ITS VALUE AND INFLUENCE UPON RECOVERY[1]

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MAN is a born explorer. The spirit of adventure has existed within him since time began. In studying the history of man we have found him ever trying to extend the frontier line of his abode to find out what is across the river, within the forest or beyond the mountain range. Sometimes this restlessness was through fear; the savage, for instance, in seeking a denser forest or a safer cave. Sometimes this change of abode was to find a soil more fertile or pastures more green; sometimes it was to seek gold and other precious metals; and sometimes it was simply to find out that which he did not know and understand.

[1] Presidential address delivered before the thirteenth annual meeting of the Alabama Academy of Science at Auburn Polytechnic Institute, March 20, 1936.

Now since the entire land surface has been explored and mapped, he has turned to other realms of interest. He is exploring the depths of the sea, giving most interesting descriptions of strange creatures that we never knew existed before. Though dangerous as it may be, the adventurous spirit of man and that burning desire to know things will continue to push him forward until the life within the sea will be as familiar to him as the life upon the land. He is continually building stronger equipment, safer balloons to further explore the infinite space beyond the earth's atmosphere. The desire to know is so great that a feeling of fear does not exist. Instruments have been and are still being constructed that increase a million times

the power of the natural eye. With such instruments he is constantly discovering new stars and classifying them in their relationship to the solar system. He can measure distances through space as accurately as he can locate points on the surface of the earth. Of all expeditions ever made the one to the Antarctic region led by Rear Admiral Byrd was one among the greatest. Such could not have been accomplished a half century ago. Every science contributed something toward his success. In transportation he utilized the ship, the tractor, the dogtrain, the airplane to penetrate the ice-covered land and sea and to traverse the floes of ice to reach the pole. In the use of various recording instruments, the radio to communicate with his base, the camera and other inventions of American genius, Rear Admiral Byrd and his group of trained scientists have made a contribution to geography and the other sciences beyond the conception of the imagination. He states in "Skyward," "Exploration has always been a battle between man and the elements." Such is true, and the spirit in which Byrd's contribution was accepted signifies the universal interest in the different sciences.

All these different types of explorers have their place in the scheme of things, but there is another class of explorers that touch our lives in numerous ways. They are the "wonder workers" of the research laboratory. At the present time there are 1,500 or more of these laboratories scattered through the country, not including those of the large universities elaborately equipped. Nor does this number include the many departments of government that are assigned to research and investigation for the advancement of science and government. Such workers, numbering many thousands of men, are not only guiding industries but are establishing new policies and new relationships resulting from new discoveries and new inventions.

Further remarks will be restricted largely to efforts and influences of the research chemists.

Scanning the sky of depression, business sees a ray of light in the achievements of chemistry which may bring a new era of prosperity. The late Dr. A. D. Little, consulting chemist of Cambridge, Mass., puts it this way: "We may look with confidence to chemical industries for contributions which should go far toward supplying the stimulus essential to revival of our prosperity."

It is a well-known fact that advances in chemistry react on every industry, while, conversely, every progressive trend in other industries makes new demands on chemistry.

The approach to the Hall of Science at the Century of Progress was so arranged as to present to the visitor some of the concepts of the phenomenal development of chemistry as a symbol of the contribution of science to the human race. By means of the strikingly beautiful murals there were depicted the growth and the development of chemistry and its applications to industry, commerce and medicine. It is the natural tendency for the individual scientist to believe that the particular branch of science in which his interest lies is of basic importance in its contribution to human knowledge and thereby to human progress. The chemist, however, can claim with some justice that in his field—chemistry—all the sciences find there common meeting ground.

There is probably no other of the sciences which touches our lives as we live them to-day in as many ways as does chemistry. The chemist has done his part to make our lives longer and more pleasant.

Since the industrial revolution science has been the handmaid of industry, making possible the large-scale production of modern times. Scientific research has been stimulated by large industries, and vast expenditures have been made on laboratory equipment for the purpose of increasing production. Every scientific advancement means more efficient production of commodities and greater profit for business. Since the world war, scientific research has been accelerated, and the amazing results of our modern industrial technicians have created a technological revolution. The highest efficiency in machine production has been achieved, and the aims of industrial science are to conserve energy, eliminate waste and utilize all the by-products of industry for the purpose of achieving the maximum production at the minimum of cost. Big business has encouraged inventions, and through large-scale production has brought to the masses comforts and luxuries beyond their dreams.

To fulfil the requirements of the various industries for chemical aid in the development of their special interests the necessity for chemical control has so increased that these various fields have virtually become specialized departments of applied chemistry, with the chemist and his process in full control. This has meant that the fields of chemistry have become more extensive, that they have been developed to a greater depth in order to solve the numerous new problems which call for hosts of new materials with specifically designated properties increasing more and more in rigid specifications. This has resulted in chemistry building up the materials for the various industries resulting in the development of the new chemical industry, which is becoming larger and larger and assuming more and more importance in the development and advance of our civilization.

In the industries to-day the development of chemical operations has reached the point where none of our factories can operate without chemicals; as in the case of agriculture, which is dependent upon fertilizers and insecticides; and the textile industry, which requires bleaching materials and dyes. These examples could be greatly extended, to say nothing of transportation,

communication—the telephone, telegraph and radio—medicine, the electrochemical industry, and even the arts—all must have their essential chemical supplies.

The biochemist, with the discovery of the several vitamins, has brought strongly to our attention the need of certain varieties of food. He also has shown the need of a variety of proteins. The industrial chemist working with the engineer has made it possible to preserve all kinds of food in all seasons. The common refrigerants—ice, ammonia and sulfur dioxide—are being replaced by solid carbon dioxide commonly known as dry ice. This refrigerant is being used extensively in keeping vegetables and fruits cool and fresh while in transit from California to the East. Space in cars is conserved and time is greatly reduced. No one knows better than the ice dealer himself what the possibilities are in the extensive use of this almost new refrigerant. We have comfortable homes in winter. We are to have comfortable homes in summer. Air conditioning is in its infancy, but expanding rapidly. Air conditioning and refrigeration in general require the use of a chemical under pressure in the apparatus to produce low temperature. The danger of accident from the escape of ammonia makes its use unsatisfactory for the refrigeration of buildings. Therefore, the product—di-chlor-di-fluoromethane—developed some time ago by Thomas Midgley, seems to meet all the requirements of safety and service in this new field. There are other refrigerants that give promise as well. The specifications of all future office buildings and no doubt many homes will include air conditioning as well as heating and plumbing. In your car there is room for your baggage and radio; space will be found for a refrigeration unit. The railroads are competing with one another in adopting this new condition, using dry ice. There is a big concern in Illinois that has more than doubled the force in air-conditioning trucks for the handling of fruits, vegetables and milk for the market.

The improvements and economics in flour milling and blending, in bread and cracker manufacture, in the making of butter substitutes, in the keeping up of quality of our food generally, can be attributed largely to the work of the chemist.

In order to grow plants for food, food for plants must be present in the soil. As the soil is cropped from year to year it becomes exhausted of its plant food and we may say it must be fertilized. This fertilizing was done originally by the use of barn-yard manure and other animal waste, but since the supply of these materials was very limited, not over 25 years ago prominent students were predicting that within a generation or so the people of the world would begin to starve because of soil exhaustion. This worry was over the supply of nitrogen, the principal source of which was from the beds of sodium nitrate in the desert of Chili. But to-day the agriculturalist knows his soil and fertilizers as well as the baker knows his flour and his baking powder. The chemist, realizing the situation, turned to experimental work for the recovery of nitrogen from the atmosphere. There are several processes in the fixation of nitrogen, differing only in degree. All methods use high pressures, high temperatures and a catalyst. Success has been beyond expectations of the industry, and the synthetic product has now largely replaced the natural product. The chemist has not only given to industry and the world an inexhaustible supply of this essential plant food—nitrogen—but in so doing has almost bankrupted the country that held a monopoly of the product that contained this element. Nitrogen recovered as ammonia is being used largely to-day as a raw material for other products. Nitric acid so produced is used in the manufacture of dyes, nitro-cellulose products, explosives, plastics, lacquers, celluloids, urea ammonia solutions and other fertilizing materials.

The research department of du Pont has not by any means been idle during the depression. Backed by du Pont's millions these "wonder-workers" have introduced many new products. In the synthetic resin group alone some products are predicted to become as serviceable and profitable as Cellophane. "Dulux," a paint, has already attained a very prominent position in the finishing field. This product is destined to rival "duco," a lacquer in the auto industry. "Gordinola" is expected to revolutionize the soap industry.

Rayon was at one time referred to as artificial silk, but chemically it is the same as cotton. Cotton or cleaned wood-pulp is treated with the proper reagents to produce a jelly-like mass. This jelly is pressed through tiny holes into solutions which cause it to set. Each little stream of jelly produces a fiber of rayon; these fibers after being cured and washed can be dyed, spun and woven into cloth of great beauty. The demand and production are certainly increasing and the quality is being steadily improved. So we may look for more and better silky fabrics.

Our attention should be drawn to the improvement made in dyes. At one time the United States was almost entirely dependent on Germany for its dye supply. During the world war this supply was cut off and we were stimulated to make our own. Now we are independent of the rest of the world and, besides the old standard colors, many new ones have been produced, as is evidenced by the dyed fabrics now being used. Not even the rainbow or the sunset can rival the artificial colors in richness and in variety.

While the dye chemist has been improving the number and quality of his products, the rubber chemist has been very busy. By research and experiment he has learned how to make tires and tubes and rubber goods which wear several times as long as similar

articles did a few years ago. This has come through improved methods of curing the rubber latex, of vulcanizing and applying the rubber. Much progress has been made in preventing the deterioration with age by the addition of so-called anti-oxidants. Mr. J. D. Tew, president of one of the largest rubber companies in the country, told the National Research Council only recently that his company was producing several thousand distinct products. Similar work is being done by other companies. Many of these products were produced intentionally, yet many came into existence by accident, and an example of the latter—rubber under certain conditions—would adhere tenaciously to metal surfaces. Investigation of this phenomenon resulted in the Goodrich Vulcalock process, by which rubber is bound to a variety of materials such as steel, glass, concrete and other surfaces. Commercially speaking, we now have pipe lines, vats, evaporators and other equipment used in process work, lined with rubber. There are now several hundred railroad tank cars in service lined with rubber, handling materials of a corrosive action safely and satisfactorily. It was the rubber chemist who came to the rescue of the commercial airplane service, thereby permitting service in all kinds of low temperature weather. The rubber de-icer for airplanes makes it possible by means of compressed air to inflate and deflate rubber sheathing on certain parts of the wings, thus breaking the ice as it forms, permitting it to fall to the earth.

Big business utilizes science to create numerous by-products from raw and finished materials and from waste products, and in this way fortifies itself against the possible exhaustion of any basic raw material which would endanger modern industry. Although American crude oil is now so cheap as to be causing acute economic distress in several oil fields, the supply is not inexhaustible, and chemists are already prepared to make gasoline and lubricating oil out of coal. Much has been said about low temperature carbonization of coal and the greatly increased recovery of oil and tar during the past decade, but there is not much encouragement for the coal operator in this country for two reasons—he is reluctant to admit that coal is a raw material and not a finished product, but the most important reason is there exists to-day in this country an abundance of cheap natural gas, cheap artificial gas, cheap fuel oil and cheap electricity so that low temperature processing is not economical. Yet the research chemist has done his part and, when economic conditions justify, the process will become active.

The mention of motor fuel from coal should remind us of the improvements made in gasoline as well as economies in its production. Much of the crude petroleum as it comes from the wells contains perhaps 20 per cent. of light hydrocarbon which might be classed as gasoline. Yet by process of cracking it is not unusual to produce upward of 70 per cent. of gasoline from the crude oil. The less valuable oils are broken down into lighter ones which are commonly considered gasoline. This makes for a much more efficient utilization of this great natural resource.

In the field of electricity, the problem of using the vast energy of the sun for human purposes is nearing a solution. Dr. Bruno Lange, of the Wilhelm Institute, has recently perfected a device which converts sunlight into electric current more completely than ever before, at a price which may compete with the present hydroelectric installations. This remarkable achievement of modern science also partly solves the problem of the exhaustion of the earth's coal supply, and will give us access to more power than ever before. An expansion of human engineering activities to a new scale, similar to what happened after the invention of the steam engine, is foreshadowed by this latest development in photo-electricity. Talking pictures, television and automatic controlled devices in every branch of technology will be the first no doubt to benefit by the new light-sensitive cell.

The light-sensitive vacuum tubes, containing potassium or caesium, which have played a fundamental part in recent developments, will probably be replaced in most of their uses by the cheaper and simpler Lange device.

In addition to producing energy out of the sun's radiation, these photo-cells will be utilized in many ways. The sensitivity of these cells is nearly the same as that of the human eye and the cells are peculiarly sensitive to color differences and have a sufficiently large output of energy to be used for many purposes without amplification. Microscopes for metallurgical purposes have been built, the ocular of the microscope being replaced by these cells. In transmitting phonograph records infra-rays have been used instead of the usual disks. All sorts of signaling methods, through dense fog, are made possible to signal ships in fogs. It will enable aviators to determine the sun's position while flying through clouds.

Getting a scarce product from a different source is one thing, improving the product or making an entirely new one is another, and these doers of the impossible are versatile.

Take glass, for instance. The very first characteristic of glass that occurs to you is its fragility. It has to be handled with care, but in a research laboratory recently a man tossed a glass lens into the air and let it fall on a concrete floor. Repeatedly the lens fell from a height of ten feet without even chipping. This lens was not fabricated of thin laminated sections like an automobile windshield; nor was it reinforced by wires or any other mechanical aids; it was a solid piece of clear optical glass—tough glass that can be

broken if you insist on it, but your blow must be many times as great as that required to break a similar lens of ordinary glass.

The chemists make this tough glass by violating a long-established rule of factory practice. The prevailing idea is that after a piece of glass is poured or cast, it must be cooled slowly, but tough glass gets no such consideration. It is plunged from a heat of 1,500 degrees or more into a bath of oil at 400 degrees, and by that sudden change of temperature the toughness is imparted. The exterior layer solidifies before the interior does, and in the slow contraction of the interior tensions are set up which oppose and counterbalance exterior blows.

Glass suggests building materials—for glass brick and glass paneling and glass columns are now on the market, and houses with a wall or a roof of glass have recently been constructed. The chemists have added to glass the ability to filter the solar heat rays and transmit only the rays of light, so a glass house may be cool, and it may be proof against the stone-thrower too, for toughness is not confined to optical glass.

Also just out of the laboratory are artificial stones and artificial woods made of waste; stainless metals made of new alloys, synthetic resins made of new chemical combinations. A typical example of the last named, and also of modern synthetic chemistry, is vinylite, developed at the Mellon Institute in Pittsburgh.

Visitors to the Century of Progress Exposition will remember the three-room apartment fashioned entirely of this new stuff out of a test-tube—the floors of vinylite tiles, the walls of vinylite panels, the baseboards, mouldings, sills, ceilings, all of the same; each door a single piece of vinylite, cast and pressed into shape; even the windows a translucent vinylite. Whole tables, desks, chairs, chests and other articles may be had in one piece.

About fifty years ago young Hall, in a woodshed and with a hand-made makeshift for a furnace, after many experiments and seeming failures finally obtained metallic aluminum from clay. Compare his workshop with the acres of buildings at Alcoa, Tenn., filled with all kinds of furnaces, heavy machinery and rolling mills turning out all kinds of aluminum products from cooking utensils to massive equipments; yes, out of this white, light metal—a competitor of steel in its variety of applications exists.

It is a long story from the trunk of a tree rolling down an incline to the modern ball-bearing, accurately balanced wheel of the automobile, or the steam turbine speeding at the rate of 3,600 or more r.p.m., yet the radical changes in the application of aluminum and different stages in the development of the automobile were made during the last few decades. In every instance you will find the research man just one step ahead of every change of any importance.

And those swift streamlined passenger trains—they can be credited to the chemist's crucible quite as much as to the mechanical engineer's slide rule, for there is hardly a material in the new trains that did not come out of recent research. Even locomotive parts are being made of light-weight alloys. One train of three cars weighs no more than a single pullman car of all-steel construction.

Before finishing, we ought to be reminded of the progress made by the biochemist in the field of medicine. We know of the vitamins and their importance to health. We have heard of insulin, discovered at the University of Toronto, which brings hope and comfort to the patient suffering from diabetes. We know that typhoid fever and many other contagious diseases are completely under control from the constructive work on the part of the individual and group of individuals in medical science. It will be only a short while before cancer and heart failure will be similarly controlled.

In the field of antiseptics much has been accomplished. Dakin's solution, a new tried solution of sodium hypochlorite, did wonderful service during the war in preventing gangrene and is still used in hospitals. Even more useful is choramine T, a close relative but more stable and less irritating. Very important and interesting is hexyl-resorcinol, which is 50 times as powerful as carbolic acid and yet can be taken by mouth. It disinfects the blood stream and especially the kidneys and renders the urine sterile.

Besides antiseptics have come new anesthetics, and in addition to cocaine for local anesthesis, we now have procaine, apolthesine, butyn and others for special purposes which are less toxic, cheaper and are not habit-forming. The chemist has learned to associate certain structures in the molecule with specific effect, so can make a drug with almost any given desired effect.

Of very great interest and importance is the study of the secretions of the so-called ductless glands. For the relief of those who have asthma, or heart failure, we now have adrenalin. It not only is of use as mentioned, but stops bleeding locally where injected, by causing a contraction of the blood vessels. This substance has been synthesized and its structure is understood so that it can be prepared pure and of definite strength. Another product rather recently discovered is thyroxin, a substance present in the thyroid glands, connected in its effect with growth and metabolism control. Studies bringing much information about the pituitary and other glands and the so-called hormones connected with them have been very fruitful, and medicine is profiting greatly therefrom.

We might go on in other fields, and at every turn we should find the chemist doing his part in the prepa-

ration, purification, protection or improvement of practically everything with which we come in contact. There is no science which has more to do with our lives and habits of living than the science of chemistry.

In conclusion permit me to say that I have refrained from discussing more recent discoveries and the many new products of the research laboratory for the reason that the true commercial value of them has not yet been determined. "Luxuries of to-day become necessities of to-morrow." Many, many products are often developed and their value proven conclusively, yet months and sometimes years elapse before any very great activity occurs putting said products on the market. The research man, though seemingly slow, is ever seeking after truth—truth as expressed in the laws of nature.

Dr. Carver, the Negro scientist of Tuskegee, summarized well the work of the research chemist when he said of his own work, "I simply try to think the thoughts of the Almighty after Him. Humbly I try to utilize some of the many things He has placed here for our benefit."

Yes, 'tis true, these "wonder workers" are ever striving, pushing forward, to know and understand more fully the laws that govern and control the universe, thereby creating opportunities so that they and others may render greater service to humanity.

OBITUARY

JOSEPH N. HARPER

DR. JOSEPH N. HARPER, widely known in connection with soil fertility interests in the South, died at his home in Atlanta, Georgia, on July 1.

He was born on March 11, 1874. He began his advisory career with his appointment in 1898 as agronomist to the Kentucky Experiment Station, where he made notable contributions on the culture of tobacco, wheat and hemp.

In 1905 he was called to head the Department of Agriculture of Clemson College, South Carolina, and to direct the activities of the South Carolina Experiment Station. These positions he held for eleven years, and under his direction the Research Department of Clemson College became recognized as a leading experiment station dealing with problems of soil fertility and plant diseases.

Dr. Harper, in 1917, was chosen to direct the extensive work of the Soil Improvement Committee of the Southern Fertilizer Association. His sound scientific knowledge and practical judgment won for him, in his travels all over the South, the respect of all concerned with the maintenance and building up of soil fertility.

With the formation of N. V. Potash Export My., Inc., Dr. Harper became a director of this company's agricultural and scientific bureau, in charge of the southern territory, which position he held until the formation of the American Potash Institute in July, 1935. For the institute he was manager of the southern territory.

Dr. Harper held memberships in many scientific societies and had held every office in the Association of Agricultural Workers, which is composed of the leading agriculturists of the South. It has been said of him that his success was due not only to his scientific knowledge, but to his practical knowledge of farming, and that when he talked to farmers he had his own experience of a lifetime of farming from which to draw upon.

R. H. S.

RECENT DEATHS AND MEMORIALS

DR. FRANKLIN DAVIS BARKER, professor of zoology and head of the department at Northwestern University, died on July 10 at the age of fifty-eight years.

PROFESSOR JESSE EARL HYDE, head of the department of geology of Western Reserve University and curator of geology and paleontology in the Cleveland Museum of Natural History, died on July 3 at the age of fifty-two years.

DR. PERCY G. STILES, since 1916 assistant professor of physiology at the Harvard Medical School, died on July 5 at the age of sixty-one years.

WILLIAM TYLER OLCOTT, lecturer and writer on astronomy, since 1911 secretary of the American Association of Variable Star Observers, died on July 6. He was sixty-three years old.

OTTO PAUL AMEND, of New York City, who retired in 1934 as president of Eimer and Amend, manufacturing druggists, died on July 4 at the age of seventy-seven years.

WILLIAM G. MARQUETTE, JR., a graduate student of Columbia University, who had been working this summer at the Marine Biological Laboratory at Woods Hole, has died by suicide at the age of twenty-two years.

WILLIAM ERNEST DALBY, emeritus professor of engineering in the University of London, died on June 25 at the age of seventy-two years. He was an authority on the steam engine and in particular on the balancing of engines.

HENRI LEON UNGEMACH, the Alsatian mineralogist, died on June 11 at the age of fifty-seven years.

THE death is announced of Dr. Guglielmo Romiti, professor emeritus of anatomy at the University of Pisa.

THE Chicago Ophthalmological Society is establishing the William Hamlin Wilder Foundation Memorial in memory of the late Dr. W. H. Wilder, professor of ophthalmology at Rush Medical College. A fund of

$10,000 is being raised, the interest to be used to bring an outstanding lecturer on ophthalmology or allied topics to Chicago every second year to deliver the Wilder Memorial lecture. Friends of the late Dr. Wilder who wish to contribute should send their checks to the Northern Trust Bank of Chicago.

SCIENTIFIC EVENTS

THE NATIONAL PHYSICAL LABORATORY

THE annual inspection of the National Physical Laboratory at Teddington to review the work done and the advances made at the laboratory in the past year was held on July 1. The London *Times* reports that the visitors were received by Sir William Bragg, president of the Royal Society and chairman of the general board of the laboratory; Lord Rayleigh, chairman of the executive committee, and Sir Frank Smith, secretary of the Department of Scientific and Industrial Research and director of the laboratory.

The metallurgy department exhibited fragments of copper and bronze articles from Ur of the Chaldees and Homeric Troy. The department has been asked to help in determining, by microchemical analysis and microscopical examination of minute samples, the source of origin of the metal used in these objects.

In the engineering department x-rays have been employed to discover how metal begins to break. This research has shown for the first time that though the fracture of an engineering component may have been produced by any one of a great number of methods of straining, the physical state of the crystalline structures that result is in every instance the same. This applies equally to a connecting-rod in which "fatigue" has been the cause of the breakage and to a chain which has snapped suddenly when much overloaded. The same department of engineering showed a model, 10 feet square, representing to exact scale all the buildings between the Thames Embankment and Aldwych, and extending west and east along the Strand. It is intended to place this model in the largest wind tunnel and there study the effects of high wind pressures on a building placed approximately where the Gaiety Theater stands. The results of this research will throw light on the screening effect of surrounding buildings and on what happens when they are removed or altered.

The new photometry laboratory in the electricity department was open to visitors for the first time. It includes a room 145 feet long for the measurement of different types of projectors, such as motor-car headlights, signal lights and searchlights. The high-voltage laboratory, equipped with a generator of surge voltages up to 2,000,000 volts—miniature flashes of lightning—has now been provided by the Central Electricity Board with an overhead grid transmission line 3,000 feet long, erected in the laboratory grounds; and the visitors saw in action the equipment whereby the characteristics of an electrical discharge lasting only a millionth of a second can be completely analyzed. It is thus possible to study the passage of "surges" traveling along the transmission line at 186,000 miles a second, with the object of minimizing the serious consequences which may ensue when an overhead transmission line is struck by lightning.

The aerodynamics department showed a film which has been made for the Air Ministry to elucidate air flow. The air flowing past aeroplane models can be actually seen, being made visible by the production in the air current of tiny electric sparks. The sparks heat spots of air, a shadowgraph of which is produced by suitable illumination and can be photographed by a cinema camera. With a high-speed camera taking 2,300 photographs a second it is possible to analyze changes in the motion which are far too rapid to be seen clearly by the eye.

TOURS OF THE THIRD WORLD POWER CONFERENCE

PLANS for nine separate tours for visiting foreign engineers, scientists and industrialists, in company with a group of Americans, have been completed as a supplement to the World Power Conference meeting in Washington from September 7 to 12.

The tours will be held both before and after the conference. More than 700 distinguished foreigners, representatives of 48 nations, are expected to meet with some 2,500 Americans, for the sessions, which will be devoted to a consideration of "The National Power Economy." Those participating will inspect hydropower plants, research laboratories, electrical manufacturing plants, business offices of urban utilities, metropolitan railroad terminals, big dams and small dams, high-speed railroad trains in operation and under construction. Visits will be made to the plants of the utilities of New York, the General Electric and Westinghouse factories, Pittsburgh's steel mills, Niagara Falls, Detroit's automobile factories, the great dams of the west, Coulee, Bonneville and Boulder, the San Francisco Bridges, Tennessee Valley, etc.

In Washington, the discussions will be devoted primarily to the economic problems involved in the conservation of power resources and the production and distribution of power. The tours will round out the conference on the technical side. They have been planned under the sponsorship of the engineering societies and the trade associations of industries concerned with power.

Four of the tours will be given before, and will be repeated after the conference. Tour V, which goes to the West Coast, will be given afterwards only. Two special trips are planned in addition, one going to Canada and one to visit the developments on the Susquehanna River.

As the tours move from city to city, data will be collected and at the end of each tour a carefully planned round-table discussion will be held in which leading experts of this country and others will participate. American and foreign methods and theories will be compared.

Tours have been arranged that bear on five general subjects: Tour I, Mineral Sources of Energy, including parties on coal, oil, gas and internal combustion engines; Tour II, Hydraulic Sources of Energy, including parties on dams, hydro plants and hydraulic research, TVA and the larger implications of hydroelectric development; Tour III, Metropolitan areas, utilities and research, including parties on steam power plants, electrical equipment, engineering education and research and business management of utilities; Tour IV, Railroad Transport; Tour V, Major Construction Projects.

The following points are included on the itineraries:

Tour I: Pre-Conference, New York, Detroit, Cleveland and Pittsburgh; Post-Conference, New York, Pittsburgh, Cleveland, Niagara Falls and Philadelphia.

Tour II: Pre-Conference, New York, Boston, Niagara Falls, Pittsburgh, Zanesville, Knoxville and other points in the Tennessee Valley; Post-Conference, New York, Montreal, Ottawa, Niagara Falls, Pittsburgh, Zanesville and the Tennessee Valley.

Tour III: Pre-Conference, New York, Schenectady, Chicago and Pittsburgh; Post-Conference, New York, Schenectady, Niagara Falls, Chicago, Pittsburgh and Philadelphia.

Tour IV: Pre-Conference, New York, Schenectady, Chicago and Pittsburgh; Post-Conference, New York, Schenectady, Niagara Falls, Chicago, Pittsburgh, Philadelphia.

Tour V: New York, Montreal, Ottawa, Niagara Falls, Chicago, Ft. Peck Dam, Grand Coulee, Seattle, Portland, San Francisco, Los Angeles, Boulder Dam, Knoxville and the Tennessee Valley.

MULTIPLE FELLOWSHIP OF THE PITTSBURGH PLATE GLASS COMPANY AT THE MELLON INSTITUTE

DR. EDWARD R. WEIDLEIN, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced that the Pittsburgh Plate Glass Company has founded at the institute a multiple industrial fellowship.

The fellowship will study fundamental problems in the various fields covered by the activities of the company. These activities include the production of plate glass, window glass, safety glass, special glasses, heavy chemicals, paints, varnishes and lacquers. These products, which have a close economic interrelationship, are also technically closely allied, so that investigation into the technology of one can become of value in its application to another. The Pittsburgh Plate Glass Company has been active in research in its various plants, and the establishment of this fellowship marks their recognition of the interdependence of technological advances and the value of centralized fundamental research.

Dr. Frederick W. Adams, who has been selected as senior incumbent of the fellowship, is from the Massachusetts Institute of Technology, where for the past fourteen years he has been a member of the department of chemical engineering, devoting most of his time to work in the School of Chemical Engineering Practice. His staff on the fellowship includes specialists in various lines of research. Dr. John D. Jenkins, who took his undergraduate work at the University of Oregon and received his Ph.D. from the University of Wisconsin, majoring in organic chemistry, leaves the Ditzler Color Company, a subsidiary of Pittsburgh Plate Glass Company in Detroit, where he has been engaged in the development and production of lacquers and industrial finishes. Dr. Harold E. Simpson, after receiving his Ph.D. at Ohio State University and spending a year in teaching at Rutgers University, has been research engineer in ceramics for the last six years at Battelle Memorial Institute. Dr. Lee Devol graduated from Marietta College and after several years of industrial experience with the Westinghouse Electric and Manufacturing Company and the Union Switch and Signal Company, completed graduate studies at the University of Pittsburgh, where he received his Ph.D. in physics. Dr. Kenneth B. McAlpine matriculated at the University of Buffalo, received his Ph.D. at Princeton University, majoring in physical chemistry, and spent several years with the Republic Steel Company at Youngstown before joining the staff of this fellowship. Phillip W. Crist graduated this year in physics from the Carnegie Institute of Technology.

Work on the various projects which are being started includes basic studies in the technology of glass, heavy chemicals, paints, varnishes and lacquers.

WORK IN THE NATURAL SCIENCES SUPPORTED BY THE ROCKEFELLER FOUNDATION

ACCORDING to the annual report the sum of $12,725,-439 was expended in 1935 by the Rockefeller Foundation.

Appropriations to the amount of $2,426,125 were made in the field of the natural sciences, chiefly in connection with projects in experimental biology.

With regard to research involving the application of the techniques of the exact sciences to biological problems, the following grants were made in 1935: Columbia University, research in the biological effects of heavy hydrogen; Emma Pendleton Bradley Home, East Providence, Rhode Island, special research in electroencephalography; George Washington University, Washington, D. C., research in biochemistry; McGill University, research in the application of spectroscopic methods to biological and medical problems; Massachusetts General Hospital, research on the parathyroid hormone and calcium and phosphorus metabolism; National Research Council, Washington, D. C., work of the Committee on Effects of Radiation on Living Organisms; Technical Institute, Graz, Austria, biophysical chemistry; University of Chicago, research in the application of spectroscopic methods to biological problems; University of Copenhagen, special research in the application of methods and techniques of physics, chemistry and mathematics to biological problems; University of Leeds, research in the x-ray analysis of biological tissues; University of Michigan, research in the application of spectroscopic methods to biological and medical problems; University of Oxford, application of mathematical analyses to biological problems; University of Rochester, New York, research on the biological effects of heat; University of Stockholm, cooperative research in biophysics, chemical biology and cell physiology; University of Uppsala, research on the physical-chemical properties of proteins and other heavy molecules; and the University of Utrecht, Netherlands, research in spectroscopic biology.

In the field of physiology and genetics undertakings receiving aid from the foundation were the California Institute of Technology, research in general physiology; Clark University, Worcester, Massachusetts, research in neuro-physiology; Columbia University, research on the electrical characteristics of cells; Connecticut College for Women, building a research greenhouse and dark constant temperature and humidity rooms for research in plant hormones; National Research Council, Committee for Research in Problems of Sex; New York University, research in cell physiology; Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, research in mammalian genetics; State University of Iowa, special research on the physiology of the normal cell; University of California, Berkeley, research in plant genetics; University of Cambridge, Molteno Institute of Biology and Parasitology, research in cellular physiology; University of Michigan, research on the physiology of respiration; University of Rochester, research on the physiology of reproduction; and Washington University, St. Louis, Missouri, special research in nerve physiology.

Endocrinology research was aided at Ohio State University, Columbus, where work is being done on the chemical, physiological and clinical aspects of the hormone of the adrenal cortex; at the University of California, San Francisco, in a study of the chemical aspects of vitamins and hormones; at the University of Paris Laboratory of Histology, researches in endocrinology and vitamins; and at the University of Virginia, research in endocrinology.

The support of groups working on several phases of the natural science program includes aid to Leland Stanford, Jr., University, for researches in chemophysical biology; the Long Island Biological Association, Cold Spring Harbor, New York, for support of symposia; and to the University of Chicago, for biological research.

Fifty-one fellowships in the natural sciences were administered in 1935 by the foundation.

SCIENTIFIC NOTES AND NEWS

Among the honorary degrees conferred at the ninety-second commencement of the University of Michigan was the doctorate of laws on Dr. Lyman James Briggs, director of the National Bureau of Standards, and on Dr. Frederick George Novy, dean emeritus of the Medical School of the University of Michigan. The degree of doctor of science was conferred on Dr. George Wilcox Peavy, president of the Oregon State Agricultural College; Dr. Earle Raymond Hedrick, professor of mathematics at the University of California at Los Angeles, and Dr. Jacob Ellsworth Reighard, professor emeritus of zoology at the University of Michigan. Walter Percy Chrysler, chairman of the board of the Chrysler Corporation, received the degree of doctor of engineering, and Gabriel Kron, research engineer of the General Electric Company, the degree of master of engineering.

Grinnell College at commencement conferred the doctorate of science on Dr. Oliver E. Buckley, director of research for the Bell Telephone Laboratories, New York City.

Dr. Harold Hibbert, E. B. Eddy professor of industrial and cellulose chemistry at McGill University, was recently awarded the honorary degree of LL.D. by the University of British Columbia.

On the occasion of his sixtieth birthday on June 11, Dr. Alfred L. Kroeber, professor of anthropology and

director of the Museum of Anthropology at the University of California, was presented with a volume of essays on anthropology by his associates and former students. Professor Robert H. Lowie, chairman of the department of anthropology, is editor of the volume. The introductory article gives personal reminiscences by Dr. Carl L. Alsberg, of the Food Research Institute of Stanford University. A bibliography of 175 items, arranged chronologically, brings the volume to a close.

DR. WILLIS G. GREGORY, who retired from the deanship of the School of Pharmacy of the University of Buffalo this year, was recently given a dinner to mark the fiftieth anniversary of the founding of the school and the fifty years of Dean Gregory's service to it. He will retain his connection with the school as a teacher.

DR. ALLAN P. COLBURN, of the department of engineering of E. I. du Pont de Nemours and Company, has been chosen to receive the William H. Walker award of the American Institute of Chemical Engineers. The purpose of the award is to stimulate interest in improving the quality, clarity of expression and practical utility of contributions to the literature of chemical engineering. It is given annually for the best paper presented before the institute and published in its transactions. The title of Dr. Colburn's paper is "A Method of Correlating Forced Convection Heat Transfer Data and a Comparison with Fluid Friction."

OFFICERS of the Linnean Society, London, for 1936–1937 were elected at the recent annual meeting as follows: Dr. W. T. Calman, *president;* Francis Druce, Dr. John Hutchinson, Dr. Margery Knight and Lieutenant-Colonel R. B. Seymour Sewell, *vice-presidents;* Francis Druce, *treasurer;* John Ramsbottom, botany, and Dr. Stanley Kemp, zoology, *secretaries.* The new members of the council were Captain Cyril Diver, M. A. C. Hinton, Professor R. C. McLean, Charles Oldham and Dr. Fred Stoker. Dr. Calman took as the subject of his presidential address "The Origin of Insects."

PROFESSOR JAMES G. NEEDHAM, head of the department of entomology at Cornell University, retired at the close of the academic year.

R. H. WALCOTT, curator of the Industrial and Technological Museum of Victoria, Melbourne, Australia, has retired.

DR. ROSS AIKEN GORTNER, head of the department of agricultural biochemistry of the University of Minnesota, writes that students of the department who recently became doctors of philosophy at the university have received the following appointments: Alva Rae Patton, assistant professor in the department of animal industry at the Arkansas Agricultural Experiment Station; Vernon Frampton, assistant professor in the department of plant pathology at Cornell University, where he will develop work on the chemical nature and control of virus diseases; Robert Jeffrey, assistant chemist at the Kentucky Agricultural Experiment Station, where he will study chemical processes involved in the problem of tobacco curing. Since 1934 he has been associated with the Research Laboratories of General Foods, Incorporated.

DR. O. K. RICE, for five years instructor at Harvard University, has been appointed associate professor of chemistry in the University of North Carolina. Dr. H. Ward Ferrill, of the University of Chicago, has been appointed associate professor of physiology in the Medical School.

DR. MARVIN A. STEVENS, who left the Yale football coaching staff to become head coach at New York University, has been appointed an assistant clinical professor of orthopedic surgery at the Yale School of Medicine. He will assume his new work in September, at the same time retaining his New York University post. Dr. Stevens also was named as orthopedist at the health department of Yale University and was appointed to the staff of New Haven Hospital.

DR. W. R. TWEEDY has been promoted to the rank of professor and head of the department of physiological chemistry of the School of Medicine of Loyola University, Chicago. He succeeds the late Dr. W. C. Austin. Dr. Fred L. Humoller has been appointed instructor in the same department.

AT the University of Arkansas, Dr. Rolland H. Waters, associate professor of philosophy and psychology, and Dr. David Causey, associate professor of zoology, have been promoted to professorships.

DR. GILBERT COOK, professor of mechanical engineering and head of the department of civil and mechanical engineering at King's College, University of London, has been appointed Regius professor of civil engineering and mechanics in the University of Glasgow, in place of the late Professor John Dewar Cormack.

DR. H. A. JONES, head of the division of truck crops in the College of Agriculture of the University of California at Davis, has resigned to accept a position with the Bureau of Plant Industry of the U. S. Department of Agriculture.

T. H. HOPPER, chairman of the department of agricultural chemistry at the North Dakota Agricultural College, has been appointed a collaborator of the Regional Soybean Laboratory established by the U. S.

Department of Agriculture at the University of Illinois. The laboratory will collaborate with the experiment stations of twelve states, with the Bureau of Plant Industry and with the Bureau of Chemistry and Soils.

Dr. N. E. Woldman has resigned as senior materials engineer of the U. S. Naval Gun Factory, Washington Navy Yard, to become chief metallurgical engineer and assistant to the vice-president of the Eclipse Aviation Company, East Orange, N. J.

Walter R. Lindsay has been appointed acting director of the Canal Zone Experiment Gardens with which he has been connected for the past five years. He succeeds Dr. J. E. Higgins, who retires from the directorship to devote his attention to special plant problems at the gardens and to plant introduction and utilization.

Leave of absence from Princeton University for the coming academic year has been given to Professor William T. Richards, of the department of chemistry; for the first term of the year to Associate Professor Richard M. Field, of the department of geology; and for the second term to Professor Paul MacClintock, of the department of geology, and Professor Wilbur W. Swingle, of the department of biology.

F. A. Silcox, chief of the U. S. Forest Service, sailed for a four-months trip to Europe on July 8 to study forestation and drought conditions abroad with a view to seeing what improvement can be made in the United States. The trip is being financed by the Carl Schurz Foundation and will include a study of the shelter-belt system in central Europe, the Mediterranean countries and the Scandinavian peninsula.

Dr. T. J. LeBlanc, professor of preventive medicine at the College of Medicine of the University of Cincinnati, sailed from New York on June 18 with a group of selected medical students for field work in tropical medicine offered with the cooperation of the School of Tropical Medicine of San Juan, Puerto Rico. Dr. LeBlanc was on June 9 the principal speaker at the sixty-fourth annual banquet of the medical alumni of Western Reserve University School of Medicine in Cleveland. His subject was "Human Biology and International Affairs."

The department of geology and geography of Northwestern University reports that during the past academic year two series of exchange lectures were sponsored by the department. Dr. Erwin Raisz, of the Institute for Geographic Exploration of Harvard University, gave five lectures on "Geographic Illustration" at Northwestern University; Professor W. H. Haas, of Northwestern University, lectured on "The Geography of the Tropics" at Harvard University; Professor W. H. Bucher, of the University of Cincinnati, gave five lectures at Northwestern University on "Problems of Geotectonics," and Professor W. E. Powers, of Northwestern University, lectured at the University of Cincinnati on "The Geology of the Pleistocene."

The first of the two summer meetings of the Botanical Society of America was held at New London, Conn., from June 17 to 19, with about fifty members in attendance. Headquarters were at the Connecticut College for Women, and the members of the society were housed in its dormitories. The only formal meeting was on June 17, at which the society was welcomed by President Katharine Blunt, of Connecticut College, and two invitation papers were presented: "Research Progress and Opportunities in the New England Marine Algae," by Professor William Randolph Taylor, of the University of Michigan, and "The Migration of the Coastal Plain Flora into Southern New England," by Professor Merritt Lyndon Fernald, of Harvard University. Three field excursions occupied the remaining time. On June 18 the society visited Montauk Point, Long Island, for the study and collection of marine algae and the flowering plants along the coast. On June 19 a trip was made to Lantern Hill and to the Larrabee Oak, the largest oak in the state park, where there was an excellent display of native vegetation and interesting species. The guides were Dr. W. R. Taylor and K. P. Jansson. The second summer meeting of the society will be held at Laramie, Wyo., from July 27 to 30.

Members of the American Phytopathological Society from the upper Mississippi Valley met at Iowa State College on June 25 and 26. In addition to the program of discussions there were excursions to the Northern Iowa Experimental Farm at Kanawha, to the Southeastern Farm at Conesville and to the Western Iowa Fruit Section at Glenwood.

Steps to incorporate the Princeton Geological Association were taken at the annual meeting, which was held at the Mining Club, New York. This action is to enable the association to acquire the site of the geological research camp at Red Lodge, Mont., and to lease it to a research group headed by Professor W. Taylor Thom, Jr., of the department of geology. At the conclusion of the business meeting, Professor Edward Sampson, chairman of the department of geology, spoke of the many different projects that will be undertaken by field parties in various parts of the world during the coming summer.

The one hundred and fourth annual meeting of the British Medical Association opened in Oxford on July 17. The statutory annual general meeting will be held

on Tuesday, July 21. The popular lecture will be given by Dr. R. R. Marett on July 24, the subject being "Anthropology and Medicine." The sections will meet for three days from July 22 to 24.

IN accordance with the settlement of the estate of the late James Loeb, banker of New York City, who died three years ago, Harvard College receives the sum of $829,793.

THE work of the Rothamsted Experimental Station in the study of soil science, plant nutrition and plant disease is reviewed in a report for 1934 recently issued and summarized in the London *Times*. The activities of the station include experiments on the parent farms at Rothamsted and Woburn, amplified by similar trials at outside centers, and in the laboratory the application of chemistry, physics and biology to problems arising in crop production and utilization. The results of recent fertilizer investigations are summarized and detailed accounts given of the field experiments in 1934. In a series of review articles on the contribution of some of the departments to soil science, Dr. Keen writes on soil physics; Dr. Crowther on chemistry of soils and fertilizers; Dr. Thornton on soil bacteriology, and Mr. Cutler on general biology. Sugar beet growers will find interesting the results of extensive fertilizer tests carried out in conjunction with the factories; nitrogenous manures were the most important in improving sugar per acre in 1934. Accurate information on the effects of organic manures, and in particular of dried poultry manure, is beginning to accumulate. Work has been continued on the maintenance of organic matter by ploughing in straw, or manures made from straw, or green manures, and, in conjunction with the continuous cereal plots testing the effects of bare fallowing, is of special bearing on soil fertility under mechanized cereal farming. In addition to fertilizer tests, problems in general husbandry are being studied. For example, the preliminary results of comparisons of electric motors with oil engines for threshing are on record. The report also contains a summary of the Rothamsted work on virus diseases. It has been found that the inoculation of a plant with one strain of virus may protect it against a later inoculation with another more virulent strain of the same virus. The part played by insects in the transmission of these diseases is discussed in the light of recent experiments.

DISCUSSION

ROYAL PALMS IN UPPER FLORIDA

THE royal palm of Florida, *Roystonea floridana*, the most striking member of the endemic flora, was nearly exterminated in the pioneer period, with the egret, the flamingo and the parrakeet. Ponce de Leon may have seen an undevastated Florida canopied by thousands of royal palms, with their huge pendent clusters of grape-like purple fruits feeding great numbers of wild turkeys, deer and other game. The royal palms grow twice as tall as the palmettos, a hundred feet or more, and far overtop the tropical forest. The early accounts of Florida as a terrestrial paradise, "the fairest, fruitfullest and pleasantest of all the world," may have had more warrant than critical historians have believed.

The pioneer period of cabbage-cutting and grass-burning lasted more than three centuries, and the royal palms were reduced to a few scattered groups protected from fire by open water or belts of deep swamps, remote from human habitation and well-nigh forgotten. The first to be recognized as a royal palm, by Cooper in 1859, was an isolated individual on the site of the future Miami, and Cooper heard of others "in large groves between Capes Sable and Romano," but little information could have been current or the palm-groves would have been visited by exploring naturalists like Townshend, Ober and Henshall.[1] By the end of the century the west coast palms had been depleted to furnish tropical settings for winter hotels at Miami, Palm Beach and Fort Myers. Only one group of the wild royal palms has been preserved and made accessible to the public, at the Royal Palm State Park southwest of Homestead, and a part of this small reservation burned over a few years ago.

Several larger groups remained undisturbed till recent years in the Big Cypress Swamp east of Naples. When the Tamiami Trail was opened, many of the palms could be seen along the sky-line, that later were set in the triumphal avenue of a racing establishment near Miami. Dirigibles were used to locate other groups farther north, and some were found that recent fires had ravaged. Drainage and road building are increasing the fire hazards, so that complete extermination of the wild royal palms is the prospect to be faced.

Two outlying groups are known to have existed, one in upper Florida, near De Land, the other at Little River, now a suburb of Miami. The northern group was noticed only once, in 1774, but the record is authentic. The following passage in William Bartram's "Travels" was brought to my attention several years

[1] F. T. Townshend, "Wild Life in Florida," 1875; F. A. Ober, "Fred Beverly," in C. Hallock, "Camp Life in Florida," 1876; J. A. Henshall, "Camping and Cruising in Florida," 1888. Henshall made two expeditions, in 1878 and 1881.

ago by Mr. Harold H. Hume, now assistant director of research of the Florida Experiment Station:

> The palm-trees here seem to be of a different species from the cabbage-tree; their straight trunks are sixty, eighty, or ninety feet high, with a beautiful taper, of a bright ash colour, until within six or seven feet of the top, where it is a fine green colour, crowned with an orb of rich green plumed leaves. I have measured the stem of these plumes fifteen feet in length, besides the plume, which is nearly of the same length.

The tall, symmetrical trunks, green at the top, and the "plumed" leaves leave no doubt that royal palms were seen, and the locality has been identified by Cooper and Small as Lake Dexter, a few miles northwest of De Land, about twenty miles inland from Daytona, in a latitude of 29°. The fact is significant, since a tropical designation is hardly to be denied to districts where royal palms were a feature of the native forest. In the Gulf-Stream climate of Bermuda, royal palms grow at 32°, the latitude of Charleston. The Florida peninsula is enclosed by the Gulf Stream, but denuded interior districts become dry and frosty.

Small suggests a warmer climate in the century before Bartram, but surface protection often determines the survival of a young palm or other tender plant. The royal palms are specialized to live as forest undergrowth during their early development, and do not begin to fruit until the trunk is twenty-five to thirty feet tall. Frosts may be worse from clearing more land in upper Florida, but at Indian River City royal palms have lived for many years, an African oil-palm (*Elaeis guineensis*) at Orlando and a Brazilian Acrocomia at Sanford. Ball and others found little difference in winter temperatures between the celery districts at Sanford and those near Sarasota, a hundred miles farther south.

The palms at Little River, hidden among mangroves in a brackish tidal swamp, were located by Munroe and shown to Sargent in 1885, though Cooper's lone palm of 1859 probably was an outlier of this group. Munroe planted "a number of these palms" in his garden at Coconut Grove in 1886, and published in "The Commodore's Story" a photograph taken in 1906 showing three mature palms forty to fifty feet tall.

Young Roystoneas in favorable places may attain twenty feet in six years from the seed, including two or three years before setting out, where seedlings are grown in pots. Transplanting from nurseries often results in root injuries and setbacks, with survivors permanently disfigured by short-jointed, narrow trunks. The lower joints often are six to nine inches long on normally developed royal palms, and the trunk at the base may exceed three feet in diameter.

Groves and shelter-belts of royal palms would greatly enhance the scenic beauty of Florida, instead of the few that are set along streets and roadways. Thousands of young palms are needlessly sacrificed every year, that in a few seasons would build their stately gray columns and spread their burnished emerald plumes. The seeds are scattered by the birds, and great numbers of seedlings spring up, only to be hoed out with the weeds, the first-season leaves being narrow and simple like coarse grasses. If the seedlings were recognized and protected, the royal palm might become an abundant tree over most of the peninsula, to judge from the varied habitats of the wild groups, fresh and brackish swamps, reef rocks and shell mounds. Fire control and irrigation are in prospect through adjustment of water levels by canals, roadways and embankments, so that a general forest cover may be restored eventually, of palms, rubber trees and other tropical vegetation.

Allied species of royal palms in the West Indies furnish building materials and have many domestic uses. Palm-groves are specially valued in pastures or farm-yards for cattle, pigs or poultry, the dried fruits of the Cuban species showing 18 per cent. of oil in Jamieson's analysis. Another use of palm-groves is for sheltering gardens or orchards against trade-winds and hurricanes. The royal palms reef down in severe storms by shedding their foliage, but the terminal bud is wrapped in the tough leaf-sheaths and the rigid trunks remain standing, even where coconut palms are destroyed.

O. F. Cook

Bureau of Plant Industry
U. S. Department of Agriculture

ON COLLEGE SCIENCE LABORATORIES, SCIENCE INSTRUCTION AND RESEARCH

A recent announcement that the committee on standards of the American Council on Education has withdrawn the council's "Statement of Principles and Standards of Accrediting Institutions," adopted in 1924, is of possibly more than passing interest to scientific men at large. It may recall the inertia of the latter group as a whole when the current procedures and requirements for accrediting college science laboratories were first adopted, in contrast, for example, with the alert attitude of the professional societies associated with the general field of English. The writer[1] has dealt elsewhere with some of the difficulties growing out of present accrediting systems so far as they concern the conditions under which science instruction is sometimes given but in particular with situations which militate against productive scholarship, adequate tenure provisions and other difficulties of the profession which may be involved.

[1] *Science Education*, 19: 1, 1–5, February, 1935. Paper presented before Section Q—Education, American Association for the Advancement of Science, Atlantic City, N. J., December 27, 1932.

It seems fortunate that in the past a few groups of scientific men have been led to take an interest in accrediting procedures, as a consequence, most likely, of the professional problems which they encountered. Valuable results were accomplished by the science faculties at the Universities of Iowa and Missouri, the latter in conjunction with their colleagues in other liberal arts institutions of that state. Additionally, certain other state universities,[2] notably Illinois, Iowa and South Dakota, were led to formulate more specific criteria for "standard liberal arts colleges" in their regions, a procedure in which their science faculties have cooperated.

Included among the bodies which have manifested an active interest in problems associated with the accrediting process is the Academy of Science of Virginia, and doubtless the names of other organizations will occur to the reader. The *Journal of Chemical Education* performs an important service in a field which is basically related to the topic under consideration, while there has been recent evidence of increased interest in the problems of teaching biological science. Lately, there has been notice of the formation of an association for research in science teaching. Last, and quite important, have been the notable contributions towards the standardization of secondary science, its equipment and facilities for instruction by professional associations of scientists working on that level; these have already had their effect upon the teaching of science in higher education. All will grant, therefore, that conditions affecting science teaching in the colleges have changed in recent years.

Despite the preceding, however, one is forced to admit that many scientists have remained indifferent towards these matters. Indeed, it recalls accusations concerning the attitude of this group as a whole toward the social maladjustments said to have grown out of scientific research. One will readily grant that the indefinite specifications as to the equipment and facilities for science instruction, which are characteristic of the requirements of the regional accrediting associations, are workable, given properly qualified personnel and adequate financial resources. Unfortunately, as regards the questions at issue, human failure on one part or the other in the past has reduced these problems in some cases to a purely "administrative" status, which may throw it and research as well into the lap of local politics. It thus seems, and especially in view of the prevailing pre-professional requirements, that a logical way to advance science is to take all practicable measures which would insure its uniformly good teaching, regardless of any particular philosophy involved in accreditment. This, of course, would be the safest antecedent for productive work in those institutions which are lacking in any such atmosphere, such as many of the small colleges. Again, if for any reason greater uniformity in the quality of science teaching on the higher levels is desirable, then the interests of the smaller institutions become important, for they greatly outnumber the larger ones where many of the problems related to accreditment have been more or less satisfactorily solved.

Under the conditions which have been described, could leadership in matters involving the accreditment of science laboratories be conceived as a function of the American Association for the Advancement of Science and as a responsibility to be delegated to its various affiliated societies along the lines of their interests? In view of the encouragement received in this matter by organizations of secondary science teachers, there seems to be no reason why such cooperation would not be welcomed by those entrusted with the accreditment of higher institutions. Certainly, if American men of science have no interest in such questions, others who may not fully appreciate the scientific viewpoint and the considerations it endeavors to meet may decide in some cases for them. Such a procedure may result in additional professional problems and in conditions less tolerable for scientific men.

N. M. GRIER

MYERSTOWN, PA.

[2] Ella B. Ratcliffe, *Bull.*, 1934, No. 16, U. S. Department of the Interior, Office of Education, Government Printing Office, Washington, 1934.

CAUSES OF EROSION ON THE BOISE RIVER WATERSHED

RESULTS of a recent study of erosion on a portion of the Boise River Watershed in Idaho should be of interest to all conservation workers. The study was conducted by the U. S. Forest Service on 371,313 acres of the most critical part of the mountainous watershed, which furnishes the entire water supply for 355,000 acres of irrigated lands in the Boise valley.

Accelerated erosion is in progress on nearly two thirds of the portion of the watershed examined. Outstanding relationships of several factors to erosion on the area are as follows:

Gradient. The amount and severity of erosion varied directly with gradient up to approximately 35 per cent.

Aspect. The causes of erosion were mostly operative on southern exposures.

Soil. The loss of litter and organic matter through the removal of the topsoil reduced resistance of soils to erosion.

Plant Cover. Erosion conditions differed sharply on various plant types. Weed and grass areas in particular suffered severely, apparently because they were previously most disturbed by rodents and livestock grazing.

Density of Vegetation. The vegetation, when depleted to a stand of less than 30 per cent., was largely ineffective in the prevention or control of erosion. A 40 per cent. cover sufficed to prevent gully erosion under normal conditions of grazing use in the Boise Region.

Rodents. Rodents were an important factor in contributing to erosion.

Accessibility to Live Stock. Erosion varied directly with the degree to which the vegetation cover was depleted and the surface conditions disturbed by livestock grazing. This appeared to be far more important than any of the other factors studied.

The results point to the necessity of immediately restoring the plant cover to a density of at least 30 per cent., and initiating improvements in range and live-stock management which will relieve conditions on areas particularly susceptible to erosion. They also indicate the type of more intensive studies needed. Such studies are already under way. A more complete discussion of these results and their significance will be presented later.

Fred G. Renner

Intermountain Forest and Range Experiment Station
Ogden, Utah

LETTERS OF DR. WILLIAM H. WELCH

At the request of the trustees of the Johns Hopkins University and Hospital and of the immediate family of Dr. William H. Welch, I have undertaken the preparation of a biography of Dr. Welch. The work on the book is progressing, and I should be very grateful for letters written by him, which can be sent me either in original form or in copy. If the originals are sent they will be copied and then returned promptly by registered mail.

Simon Flexner

The Rockefeller Institute for Medical Research,
New York

SOCIETIES AND MEETINGS

THE SEVENTEENTH ANNUAL MEETING OF THE AMERICAN GEOPHYSICAL UNION

The seventeenth annual general assembly of the American Geophysical Union and the meetings of its seven sections were held on April 30 and May 1 and 2, 1936, at Washington, D. C., in the building of the National Academy of Sciences and the National Research Council.

The scientific session of the general assembly was devoted to a symposium on recent trends in geophysical research and included the following papers: "The Place of Geodesy in Geophysical Research," by William Bowie; "Recent Developments in the Geophysical Study of Oceanic Basins," by R. M. Field; "Trends in Seismological Research," by James B. Macelwane; "Recent Progress in the Physical Interpretation of Synoptic Weather-charts," by E. W. Wollard.

Reports were received from four special committees as follows: (1) On geophysical and geological study of oceanic basins; (2) on geophysical and geological study of continents; (3) on establishment of an American journal of geophysics; and (4) on consideration of desirability and feasibility of inviting the International Union of Geodesy and Geophysics to hold its seventh triennial general assembly in 1939 at Washington, D. C. Reports (1) and (2) will be published in the usual annual volume of *Transactions* of the Union. The executive committee was empowered to further consider reports (3) and (4) and to take action as circumstances may warrant.

An interesting feature of the assembly was the exhibits prepared by the special committee on the geophysical and geological study of continents. The central item was a relief model, constructed to scale, which showed the approximate configuration of the "basement complex" rocks underlying that portion of the United States extending from the Atlantic seaboard to and just beyond the Rocky Mountain Front Ranges. With the irregular blanket of sedimentary rocks removed from the "basement" surface the model made clear the nature, form and interrelation of both the buried and emergent mountain ranges of this region. The relations of the ranges to the profound troughs which flank them and to the more remote dome-shaped uplifts and basin-like depressions were also thus disclosed.

In order to show how "basement structure," as portrayed by the model and by its parent structure contour-map, also finds significant expression and reflection in the areal distribution of surface-sediments, in local variations in the force of gravity, in local variation in magnetic intensities and in regional variations in earth temperature conditions, maps and diagrams were also exhibited in proximity to the structural model as follows: (1) The United States Geological Survey's areal geologic map of the United States; (2) contour-map showing configuration of Pre-Cambrian surface for portion of United States east of Nevada (prepared by R. G. Moss, formerly Eleanor Tatum Long fellow of Cornell University, and now with the Phillips Petroleum Company, and exhibited by courtesy of Mr. Moss and the Geological Society of America); (3) contour-map showing configuration

of surface basement complex beneath portion of United States between Atlantic seaboard and Rocky Mountain Front (compiled by the special committee); (4) gravitational iso-anomaly contour-maps of the Eastern United States, Yellowstone-Black Hills and West Indian regions (compiled for the special committee from United States Coast and Geodetic Survey data by George P. Woollard); (5) geothermal maps showing (a) local temperatures at depths of 5,000 and 10,000 feet in United States and parts of Canada, (b) relation of structure to temperature in Salt Creek Oil Field, and (c) relation of temperature to buried topography in Eastern South Dakota (compiled for the special committee from publications by Darton, Van Orstrand and Spicer by William S. McCabe); and (6) tectonical and geophysical map of Wichita-Arbuckle Region showing relations between geologic structure of a buried mountain system and local variations in gravitational and magnetic forces (as published by A. van Weeldon, World Petroleum Congress Proceedings, v. 1, p. 174, 1933).

Five of the nine resolutions adopted were on the deaths during the year of the following members: Arthur J. Weed, Roy Jed Colony, Edwin Jay Brown, Christian Huff and Veryl R. Fuller. The other resolutions concerned national progress in geophysics and were as follows:

RESOLUTION ON TOPOGRAPHIC MAPPING

WHEREAS, In practically all phases of geophysical research a knowledge of the terrain is essential, and

WHEREAS, The best modern topographic maps show the terrain in such detail and with such accuracy as is needed for research in geophysics, either for scientific or for commercial purposes, and

WHEREAS, Good topographic maps are of very great value in operations connected with water-power and soil-conservation and in other engineering operations, therefore be it

Resolved, That the American Geophysical Union recommend and urge that the Federal Government complete the topographic mapping of this country in as short a time as practicable, and be it further

Resolved, That copies of this resolution be sent to the President of the United States, to the President of the Senate, to the Speaker of the House of Representatives, and to other Government officials who would either be concerned in carrying on the topographic mapping or who would benefit by its completion.

RESOLUTION ON NAVAL OBSERVATORY TIME-SIGNALS

WHEREAS, Accurate radio time-signals which are now being broadcast by the United States Naval Observatory twenty times daily on a certain frequency and many times daily on other frequencies are essential for seismological and geodetic investigations of special or routine character, and

WHEREAS, A published notice in the *Hydrographic Bulletin* states that the 690-kilocycle time-signal from NAL is to be discontinued on June 1, 1936, a signal which is of special value to many seismologists in the eastern part of the United States, therefore be it

Resolved, That the American Geophysical Union in joint assembly express the greatest appreciation and gratitude for this excellent time-service, and be it further

Resolved, That every reasonable effort be made by the Naval Observatory staff to continue the present schedule of time-signal broadcasts (including the 690-kilocycle signal) and, if possible, to increase it, and be it further

Resolved, That a copy of this resolution be sent to the Secretary of the Navy, to the chief of the Bureau of Navigation, United States Navy, and to the superintendent of the United States Naval Observatory.

RESOLUTION ON FORMS FOR RECORDING OCEANOGRAPHIC OBSERVATIONS

WHEREAS, It is necessary to have appropriate forms on which to record oceanographic observations made at sea and data pertinent thereto, and

WHEREAS, There is at present much diversity in the forms used by different organizations, and

WHEREAS, It is desirable to have definite forms adopted for use by different institutions engaged in oceanographic work, therefore be it

Resolved, That the American Geophysical Union authorize the Section of Oceanography to appoint a Committee to study the problem of forms to be used in recording oceanographic observations at sea and to submit recommendations at the annual meeting of this Section in 1937, and that this Committee be composed of one representative each from the Hydrographic Office of the Navy, the United States Coast and Geodetic Survey, the United States Bureau of Fisheries, the Woods Hole Oceanograpic Institution, the Bingham Oceanographic Foundation of Yale University, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the Oceanographic Laboratories of the University of Washington, the Scripps Institution of Oceanography of the University of California, and from such other institutions as should properly be included.

RESOLUTION ON EXTENSION OF HYDROGRAPHIC SURVEYS

WHEREAS, With improved methods of marine surveying developed during the past few years there has been demonstrated the existence of an intricate topography on the floor of the ocean, and

WHEREAS, The extension and amplification of this record requires not only that the zone of the surveys be extended to a greater distance seaward but also that these offshore surveys be carried out in greater detail, and

WHEREAS, The results secured in the last few years show that such surveys will give data of fundamental importance in the interpretation of the history of the Earth, the distribution of animals and plants, and, in fact, all branches of natural science, and

WHEREAS, The increasing use of echo-sounding equipment by the merchant marine makes the charted results of these surveys of value to commerce, therefore be it

Resolved, That the American Geophysical Union expres

its hearty appreciation and approval of the work done along this line by all agencies engaged therein, and also its earnest hope that means may be found not only to continue but also greatly to extend it, and be it further

Resolved, That copies of this resolution be sent to the secretaries of the governmental departments concerned.

In the Section of Geodesy 11 papers and reports were presented. Six of these dealt with progress and development of geodetic operations and instruments in Canada, Central America, Mexico and the United States; four related to gravimetric surveys, apparatus and interpretations; one concerned features of the Hawaiian Island Arc.

The Section of Seismology held three sessions jointly with the Eastern Section of the Seismological Society of America. The 22 communications may be classified as follows: Theoretical interpretations and analysis, 8; individual earthquakes and seismic measurements, 4; research in engineering seismology and applications, 3; geology and deep-focus earthquakes, 2; seismic instruments and stations, 3; progress-report for the United States, 1; earthquake activity, 1. Frank Neumann was elected secretary of the Section of Seismology for the three-year term ending June 30, 1939.

The Section of Meteorology heard nine papers bearing on theoretical aspects (2), on long-range forecasting (3), on correlation of solar and meteorological phenomena and upper-air results (3), on eclipse-meteorology (1).

Thirteen communications were received by the Section of Terrestrial Magnetism and Electricity. These were concerned with instrumental matters (3), with magnetic correlation with cosmic-radiation, radio transmission and solar activity phenomena (5), with magnetic anomalies (2), with electric exploration of the troposphere and stratosphere (1), with magnetic perturbations (1), with magnetic diurnal-variation (1). The secretary, besides reporting progress on the British Admiralty's non-magnetic vessel *Research,* submitted brief summaries of progress-reports dealing with magnetic and electric researches by 11 organizations in Canada, Mexico, Peru, Western Australia and the United States, including Alaska, Hawaii and Puerto Rico.

Eleven communications at the meeting of the Section of Oceanography related to progress during the year of five governmental and private organizations doing oceanographic work. Four papers had to do with dynamical oceanography and ocean currents. Two papers gave summaries of explorations of submarine canyons off California and between the Hudson Gorge and Chesapeake Bay.

The following nine papers were discussed at two sessions of the Section of Volcanology: The origin of lamprophyres; slopes of the walls of lunar craters; the solubility of water in magma at high pressure; two African nephelines; volcanological boron compounds; some recent studies of Sierra Nevada Pluton; crystallization of granodiorite magma, Ouray District, Colorado; origin of anorthosite in the Adirondacks and in general; mode of intrusion of Pre-Cambrian granites in central Boulder County, Colorado.

There were four sessions of the Section of Hydrology. The first two were devoted to 19 general papers —five on ground-water, two on stream-channel storage, six on surface-water and surface-runoff, one on glaciers, four on erosion and flood-control, one on evaporation. A symposium on ground-water—arranged by David G. Thompson—occupied all the third session and included eleven communications. At the fourth session the annual reports of the section's nine permanent research committees were received and discussed; these are the committees on (1) snow, (2) glaciers, (3) evaporation, (4) absorption and transpiration, (5) rainfall and runoff, (6) physics of soil-moisture, (7) underground water, (8) dynamics of streams, (9) chemistry of natural waters. L. K. Sherman, J. E. Church and K. H. Beij were elected as chairman, vice-chairman and secretary of the section, respectively, for the three-year term ending June 30, 1939.

The total membership of the Union on May 1, 1936, was 768—a net gain of 156 during the past year. There is wide-spread interest in the coming sixth triennial assembly of the International Union of Geodesy and Geophysics to be held during September, 1936, at Edinburgh, Scotland. Thus far some 30 Americans have arranged to attend and have been designated as delegates—this is by far larger than any American delegation attending any previous general assembly of the International Union.

As in previous years, the proceedings of the year's meetings—including, either in full or in abstract, 131 papers and reports of the seventeenth annual meeting above noted and some 30 papers and reports at the Pacific Coast meeting of the Section of Hydrology held at Pasadena, California, on January 31 and February 1, 1936—will be published by the offset method.

The increase in membership during the year and the notably wide geographic distribution of new members evidence continuing and increasing interest in geophysics. It is felt that no small part of this enlarging appreciation of the value of geophysical research is to be credited to the publication and distribution of the *Transactions* of the Union. That the *Transactions* play important part, both practical and theoretical, in international coordination of American progress in earth physics is shown in favorable comments by geophysicists of many countries. It is to be hoped,

therefore, that the publication of this yearly record of American progress in the geophysical sciences may be adequately maintained not only in the national interest but also because of its value in the stimulation, orientation and coordination of international endeavor in these fields.

JNO. A. FLEMING,
General Secretary

WASHINGTON, D. C.

SPECIAL ARTICLES

THE PROTECTIVE ACTION OF RABBIT SERUM FOR VACCINIA VIRUS AT HIGH TEMPERATURES[1]

VACCINIA virus rapidly loses its viability at temperatures higher than 5° C. The desirability of a medium by which its viability could be maintained at higher temperatures over a reasonable length of time has long been recognized. Otten[2] succeeded in preparing a dried calf pulp which, stored in vacuo, kept its potency for many months at tropical temperatures. This method has the distinct disadvantage of not eliminating the bacterial contamination in vaccine prepared from this source. Recently Rivers and Ward,[3] taking advantage of the fact that the vaccine virus cultivated by their method in tissue culture is free from bacterial contaminants, added one part of 30 per cent. gum acacia solution to eleven parts of tissue culture virus; and after rapid drying and sealing in vacuo, they obtained a preparation which withstood a temperature of 37° C. for at least one month. Lloyd and Mahaffy,[4] using Rivers's tissue culture virus, prepared a desiccated virus which had been diluted previously with equal parts of normal horse serum. This material stored at 28° C. showed some diminution of potency during a period of 69 days. Stored at 37° C. it could not be kept at undiminished titre longer than 14 days.

Green[5] has shown that glycerinated vaccine loses its viability completely when stored at 37° C. in about 12 days. It is generally agreed that even at a low temperature glycerine has a deteriorating effect on vaccinia virus. The great advantage in its use has been its bactericidal action on the contaminants necessarily present in fresh calf pulp. In a bacteria-free vaccine, such as can be prepared by cultivating the virus in tissue culture or in the chorio-allantoic membrane of the chick embryo, the use of glycerine is of no distinct advantage. Other suspensoids, preferably of a colloidal nature, which, when used with the calf virus, might possibly act as a culture medium for the accompanying contaminants, might prove to have distinctly more protective action for vaccine virus against high temperatures, provided no contaminants are present.

Vaccine virus cultured in the chorio-allantoic membrane of the chick embryo[6] provides an excellent bacteria-free material for testing the effect of various substances upon the viability of the virus at high temperatures. The following substances were used to prepare suspensions of the virus: 30 per cent. solution of gum acacia, 3 per cent. mucin in saline, sterile egg yolk and normal inactivated rabbit serum. Vaccine suspensions were made with these materials in the proportions of 1 part of the ground membranal lesion, which contained the virus from the 200th generation in this tissue, to 4 parts of the suspensoid. The samples were controlled by making the usual 1 to 4 suspension in 50 per cent. glycerine in .9 per cent. NaCl solution, as well as in .9 per cent. NaCl alone. The different suspensions were put up either in capillary tubes or in 1 cc amounts in sealed ampoules. These were stored at 0°C., 25° C. and 37° C. At weekly intervals the different batches were tested for potency by cutaneous inoculation on the rabbit. Dilutions of 1–10, 1–100, 1–1000 and 1–10,000 of the virus suspensions were inoculated in 0.4 cc amounts over a scarified area of skin 2.5 × 5 cm square. Readings were made on the fourth or fifth day. A freshly prepared vaccine from this source induces by this method a confluent lesion in a dilution of 1–1000 and scattered pustules at 1–10,000.

From these comparative experiments it is found that at room temperature for one month the virus suspended in gum acacia and in mucin produces only a very mild reaction in the rabbit in dilutions of 1–10. A moderate reaction is obtained from the virus suspended in glycerine, in saline and in sterile egg yolk in dilutions of 1–100. After 6 weeks at 25° C. in normal inactivated rabbit serum there was practically no diminution in the titratable potency of the virus. Fresh unheated normal rabbit serum seems to reduce the activity of the virus slightly in the first few hours. This observation is being investigated further.

Stored at 37° C. the virus suspended in mucin and gum acacia had lost its viability completely at the end of two weeks. After 3 weeks at 37° C. the glycerinated virus and that in egg yolk was completely inactive. In saline at this temperature a mild reaction was obtained at the end of three weeks, but the virus was completely inactive after a period of four weeks. These were all tested in dilutions of 1–4.

The vaccine suspended in normal inactivated rabbit

[1] Aided by grants from the Divisions of International Health and of Medical Sciences, Rockefeller Foundation.

[2] H. Otten, *Zeits. f. Hyg.*, 107: 677, 1927.

[3] T. M. Rivers and S. M. Ward, *Jour. Exp. Med.*, 62: 549, 1935.

[4] W. Lloyd and A. F. Mahaffy, *Proc. Soc. Exp. Biol. and Med.*, 33, 154, 1935.

[5] A. B. Green, *Jour. Hyg.*, 8: 536, 1908.

[6] E. W. Goodpasture and G. J. Buddingh, *Am. Jour. Hyg.*, 21: 319, 1935.

serum at the end of four weeks at 37° C. produced a strong reaction in dilutions of 1–100 on the scarified rabbit skin and at the end of five weeks it was still moderately active in the same dilution.

When suspended in serum and desiccated *in vacuo* in the frozen state and stored in sealed ampoules at 37° C., only a slight diminution in the titratable potency of the virus takes place over a period of four weeks.

These experiments indicate that normal inactivated rabbit serum, as a suspensoid, serves to maintain the viability of vaccinia virus at temperatures as high as 37° C. over much longer periods of time than do 50 per cent. glycerine or various other substances which we have used. Such a method of preserving the activity of vaccinia is of great practical importance, especially in view of the use of vaccine virus in tropical climates where transportation under unfavorable conditions is necessitated.

These investigations are being carried on further with the purpose of adapting this method to preservation of vaccine for human prophylaxis. The protective action of sera from sources other than the rabbit is also being investigated. The various details of the method will be published at a later date.

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FURTHER OBSERVATIONS ON FACTORS FROM NORMAL TISSUES INFLUENCING THE GROWTH OF TRANSPLANTED CANCER[1]

THE presence of an inhibiting factor associated with the transmitting agents of fowl tumor has been demonstrated in the extracts and filtrates of these neoplasms. When properly concentrated it has the property of neutralizing the tumor agent and furthermore will retard the growth of a transplantable mouse sarcoma (Murphy and Sturm). On the basis of these observations, Murphy suggests as a working hypothesis that growth and differentiation of cells is controlled by a balanced system comprising a stimulating force and a retarding force, a suggestion which is in line with other known physiological processes. On the basis of this hypothesis a break in the balanced mechanism leading to uncontrolled growth might take place either by reinforcement of the stimulating force or by suppression of the inhibiting force. Murphy's and Sturm's demonstration that a substance extracted from placenta and embryo skin definitely retards the growth of both transplanted and natural cancers of mice seemed to offer partial support to the general hypothesis. The present report gives further confirmation in showing two factors in active normal tissues.

The tumor utilized was Bashford Mouse Carcinoma No. 63, and the source of the factors tested was the prelactating mammary gland of 6 rabbits representing different stages of pregnancy and of one cow at about the fourth month of pregnancy. The fresh tissues were first desiccated *in vacuo* in a freezing box, and the finely ground powder was used in preparation of the extracts. The details of the experiments will be published later, but it should be stated here that they were so designed and controlled as to give each test solution equal representation in the variables associated with tumor growth energy and host susceptibility. The essential point of the procedure was the inoculation of pairs of grafts into each mouse in a series after one graft had been exposed to a test solution concurrently with the exposure of the other graft of the pair to a control solution (Tyrode's solution). For each experiment an additional group of animals was inoculated with two grafts each from the control solution. These data made it possible to analyze the results on the basis of the system developed by Karl Pearson, in particular the Chi square test for "goodness of fit" of frequency distribution.

Significant inhibiting action on the tumor growth was shown in 60 or more cases by the aqueous extracts at pH 7.0–7.3 of the desiccated mammary gland of the six different rabbits. There was no significant difference in the intensity of inhibition between the different rabbits representing a range from 12 to 28 days of pregnancy. The mammary tissue from pregnant mice and from a cow gave equally definite results. The fact that similar extracts of placentas from several of the above animals failed to show any inhibiting action at pH 7.0–7.3[2] indicates that the results with

TABLE I

TUMOR INHIBITION AND TUMOR STIMULATION AS SHOWN BY DIFFERENT FRACTIONS OF RABBIT MAMMARY GLAND

Fraction	Concentration Per cent.	Frequency of Inhibition	Frequency of No effect	Frequency of Stimulation	N	χ^2	n′	P*
Unfractionated ..	2.6	16	22	4	42	4.06	3	.13
Ether-insoluble ..	1.3	25	16	6	47	6.03	3	.049
Ether-soluble ...	2.0	3	16	25	44	11.05	3	.0040
Double controls .	0.95	12	19	11	42	Standard of reference		
Theoretical normal distribution ...		11	22	11	44	0.21	3	.90

* P = "Probability that deviations as great or greater would occur by chance."

[1] From the Laboratories of the Rockefeller Institute for Medical Research.

[2] Definite inhibition was noted when the placenta extracts were used at pH 5.8–6.3. The meaning of this observation is not clear, but it can not be ascribed to the pH, as this is within the range of non-injury to tumor cells.

the mammary tissue can not be attributed to a general foreign substance reaction.

A beginning attempt at fractionation of the desiccated mammary tissue of rabbits 26 days pregnant has yielded a strong tumor-inhibiting ether-insoluble fraction and an equally potent tumor-stimulating ether-soluble fraction. The desiccated mammary gland was first thoroughly extracted with ether and the soluble material, after evaporation of the ether, was suspended in 1 per cent. phosphate buffer. The insoluble portion of the powder was extracted with sterile distilled water. The pH of each test solution was 7.0–7.2.

The results of the tests are shown in Table I and include only those in which all the solutions were tested concurrently on grafts from the same tumor substrate and on mice from the same cage lot. A tumor growth was considered inhibited when the control in the same animal was twice the weight of the test tumor at 21 days or more after inoculation. When the test tumor was twice the weight of the control it was considered as evidence of stimulation. Following the accepted procedure, a significant difference from the normal frequency distribution depends on the value of P being less than .05. The table shows that there was an excellent fit between the frequency distribution of results from double controls and that of the theoretical normal distribution. The results demonstrate not only a definite inhibiting action of the water extract of the ether-insoluble fraction of the rabbit mammary gland, but also an equally definite stimulating property of the ether-soluble fraction from the same tissue. Furthermore, it would appear that there is a partial neutralization of the two forces in the aqueous extract of the unfractionated mammary tissue.

Additional results, including tests of both rabbit and cow glands, are presented in Table II. The results

TABLE II
TUMOR INHIBITION AS SHOWN BY FRACTIONS OF RABBIT AND COW MAMMARY GLAND

Fractions	Frequency of Inhibition	No effect	Stimulation	N	χ^2	n′	P*
Unfractionated ..	154	115	29	298	48.49	3	.000001
Ether-insoluble ..	79	43	9	131	48.02	3	.000001
Double controls ..	63	110	68	241	Standard of reference		
Theoretical normal distribution ...	60	120	60	240	1.01	3	.61

* P = "Probability that deviations as great or greater would occur by chance."

are pooled because there was no significant difference between the effects of extracts of rabbit and cow mammary tissues.

The results seem to offer further support to the idea that active normal tissues may contain two factors, one capable of inhibiting the multiplication of cells and the other augmenting the process.

DOUGLAS A. MACFADYEN
ERNEST STURM

DOMINANT LETHAL GENETIC EFFECTS CAUSED BY NEUTRONS

IN crosses of unrelated stocks of the parasitic wasp Habrobracon, all females come from fertilized eggs, all males from unfertilized. Treatment of sperm with any physical agent causing dominant lethals should therefore reduce number of female progeny. Number of male progeny should not be affected unless the sperm were themselves rendered incapable of "fertilizing" the eggs. In this case the males would be increased.

As a preliminary experiment wild-type male wasps were sent via air mail to Berkeley, California, and subjected to various dosages of neutrons by Professor Ernest O. Lawrence. Upon being returned these males were crossed with unrelated orange eyed females. Progeny (Table 1) indicate decreased fecundity of the

TABLE 1

Treatment	Total days during which progeny were being produced	Progeny: Orange males	Wild-type females	Males per day	Females per day
Control ..	70	42	139	0.60	2.00
530 R. ...	20	14	35	0.70	1.75
900 R. ...	75	43	50	0.57	0.66
1900 R. ..	65	20	5	0.31	0.08

mates of the treated males. It is likely that the fluctuations in number of male offspring are due to small numbers involved.

Although the data presented herewith are meager, they are reported at this time because the cyclotron will not be available for use for several months.

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RECOVERY OF INFLUENZA VIRUS SUSPENDED IN AIR

THE union of two independent techniques has made possible the recovery of the Puerto Rico 8 strain of influenza virus,[1] experimentally suspended in air. One of us (H. W. B.) prepared liquid suspensions of the influenza virus and confirmed, by means of animal inoculation, its recovery from air.[2, 3] The other (W. F. W.) atomized the liquid suspension of virus into

[1] Provided through the kindness of Dr. T. Francis, Jr., Rockefeller Institute.

[2] H. W. Brown. Unpublished Thesis, Harvard School of Public Health, 1936.

[3] H. W. Brown, *Am. Jour. Hyg.*, in press.

a closed steel chamber of 200 cubic feet capacity, leaving an air suspension of droplet nuclei.[4] Following atomization, samples of the air were withdrawn through siamized tubes to two Wells air centrifuges.[5] One branch led directly to one of the centrifuges; the other branch included a small chamber enclosing a cold quartz mercury vapor lamp, by means of which the air passing to the other centrifuge could be irradiated with ultra-violet light.[6]

The virus in the material recovered from the tank was identified in three ways: (1) production of the characteristic disease in ferrets; (2) virus neutralization tests in mice before inoculation and 17 to 30 days later; (3) reinoculation of the ferrets with virus of known potency.

RESULTS

(1) All the ferrets (8) inoculated with material collected from the air within an hour after suspension contracted influenza. None of the ferrets (7) inoculated with samples collected from the tank an hour or more after suspension of the virus contracted the disease. These negative tests were in general comparable to those of shorter periods which gave positive results, but in each instance some particular condition of test differed. On the basis of this exploratory study, however, the authors do not believe that they have necessarily reached a viability end-point.

(2) Simultaneous sampling under identical conditions of air, (1) as it came from the tank and (2) after irradiation with ultra-violet light, seem to indicate a definite viricidal action of the light. In two tests, the ferrets inoculated with material recovered from unirradiated tank air, suffered a typical attack of influenza, which was confirmed by virus neutralization tests. The ferrets that received material simultaneously recovered from the air of the tank under identical conditions, except for irradiation of the air, failed to show any symptoms of influenza, and virus neutralization tests subsequently showed no development of immunity.

W. F. WELLS
H. W. BROWN
HARVARD SCHOOL OF PUBLIC HEALTH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE APPARATUS FOR THE MAINTENANCE OF A GRADED SERIES OF CONSTANT TEMPERATURES

IN 1928 I designed and had constructed for the Zoological Laboratory of the Johns Hopkins University an apparatus by means of which a graded series of five different constant temperatures can be maintained. This apparatus has now been in operation almost continuously for seven years. It has proved to be very useful and efficient and extremely simple to operate.

It consists, in principle, of a series of compartments one above the other with a refrigerating unit in the upper one and a heating unit in the lower (Fig. 1 A). As actually constructed it consists of two series of five compartments side by side (12 x 20 x 20 inches each); a large refrigerating compartment (12 x 25 x 50 inches) above these two series and a heating compartment (9 x 25 x 50 inches) below. Each of the ten compartments contains two wire shelves, and each has a 2-inch space around it (Fig. 1 A). The refrigerating compartment has two trap doors above, the heating compartment two doors on hinges and each of the ten compartments one door on hinges. All the doors are constructed like those on household refrigerators, and each is provided with two gaskets (Fig. 1 B). Between the sheets of celotex and the wood boards and on both surfaces of the sheet cork there are layers of heavy insulating paper, not represented in the figures. The refrigerating compartment contains the low temperature coils of a household electric refrigerator, the heating compartment contains a bank of five 30-Watt lamps with an electric thermostat in series.

The temperature in the different compartments varies with that in the refrigerating and the heating compartments and that of the room. With these temperatures 2°, 30° and 20°, respectively, the temperatures in the five compartments in each of the two series are, beginning with the upper, 10°, 16°, 20°, 24° and 27°, respectively, with a variation under favorable conditions of approximately ½° in each.

The temperature of the five compartments in the series varies directly with that of the room. However, if this does not vary more than about five degrees there is, with ordinary thermometers, little if any observable variation in the temperature in the compartments, and this could be reduced by increasing the thickness of the outer walls and by using more efficient insulating material.

By changing the temperature in the refrigerating and the heating compartments practically any range of temperatures in the compartments desired can be obtained.

[4] W. F. Wells and W. R. Stone, *Am. Jour. Hyg.*, 20: 611, 1934.
[5] W. F. Wells, *Am. Jour. Pub. Health*, 23: 58, 1933.
[6] W. F. Wells and G. M. Fair, SCIENCE, 82: 280, 1935.

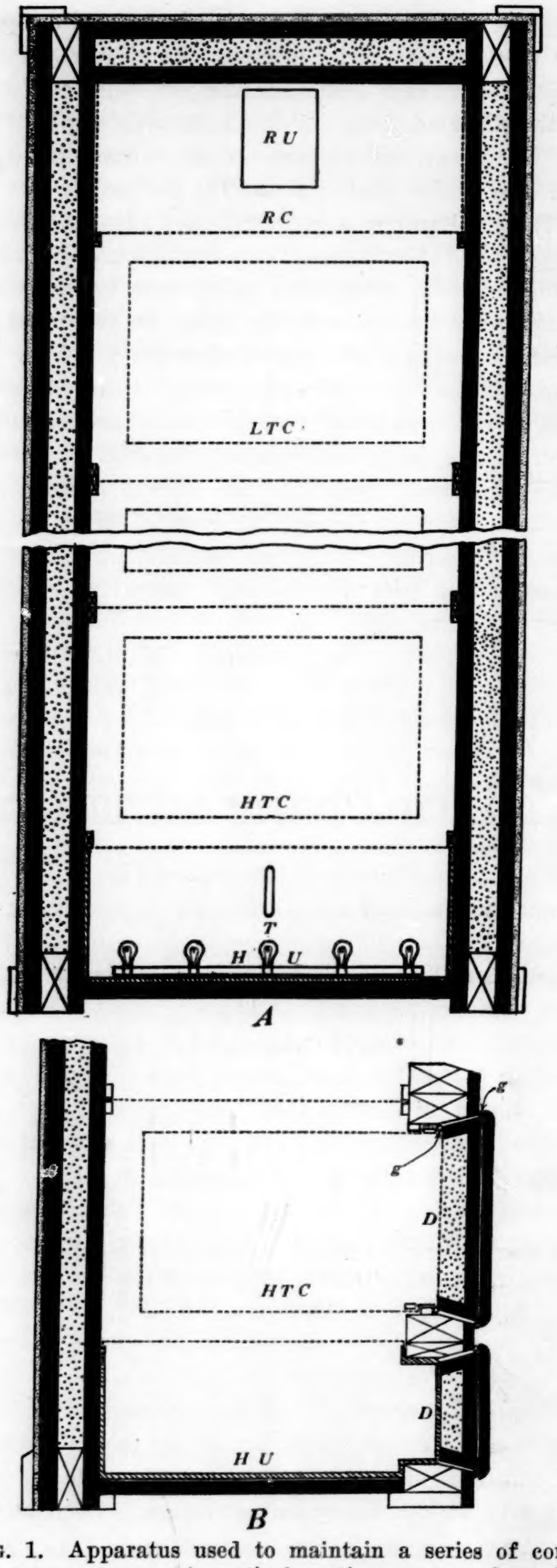

FIG. 1. Apparatus used to maintain a series of constant temperatures. A, optical section as seen from in front (middle portion omitted); B, optical section as seen from the side (upper portion omitted); heavy black lines, wood boards ⅞ inch thick; fine stipple, celotex sheet ½ inch thick; X, wood frame; coarse stipple, sheet cork 2.5 inches thick; cross hatch, asbestos board ¼ inch thick; broken lines, 14 oz. hard red copper sheet; H U, heating unit; T, electric thermo regulator; H T C, high temperature compartment; L T C, low temperature compartment; R C, refrigerating compartment; R U, refrigerating unit; D, door; g, gasket.

The apparatus was built by the university carpenter and plumber. It cost complete approximately $600. That was in 1928. The cost would now be considerably less, and this could be reduced by reducing the size and the number of compartments.

It would be advantageous to have the height of the heating and the refrigerating compartment the same as that of the other compartments and to have side doors of the same size on all, with the view of using the heating and the refrigerating compartments, as well as the other compartments, for experimental purposes.

S. O. MAST

THE JOHNS HOPKINS UNIVERSITY

A NEW COVER FOR CULTURE JARS

IN some water-culture experiments with seedlings, recently carried out at the University of Pennsylvania, the tall 500-ml Pyrex beakers used as culture jars were fitted with a new form of cover that has advantages over covers previously used for such experiments. As shown in the accompanying figure, these were Pyrex Petri-dish covers, perforated and annealed by the university glass-blower. The size and number of holes were determined by the size and number of seedlings to be used. Cotton was sometimes used where the seedling passed through the perforation, to aid in supporting the plant in an upright position. Convenient to handle and easily cleaned, these covers support no bacterial growth, and they practically prevent contamination of the culture solution.

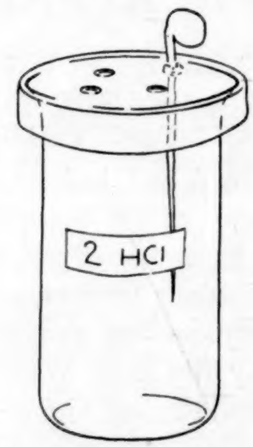

FIG. 1. Culture jar with glass top and one seedling in place.

RUTH BEALL

LANCASTER, PA.

A LABORATORY SUGGESTION

THE slightly greasy film of dirt which microscopic slides acquire after having been put away for several months can be very easily removed with "Windex," a preparation sold for washing windows.

JOHN FRANKLIN HUBER

UNIVERSITY OF MICHIGAN